LONG HILL TOWNSHIP
MORRIS COUNTY, NEW JERSEY

WASTEWATER SYSTEM IMPROVEMENTS PROJECT
NJEIFP PROJECT NO. S340404-06 & 08

ENGINEER'S REPORT

SUBMITTED TO:
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

PREPARED BY:
KLEINFELDER/OMNI

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

This Engineer's Report has been prepared to support Long Hill Township's two (2) applications (i.e. for Project No. S340404-06 and S340404-08) to the New Jersey Department of Environmental Protection (NJDEP) and the New Jersey Environmental Infrastructure Trust (NJEIT) for funding its Wastewater System Improvements Project through the New Jersey Environmental Infrastructure Financing Program (NJEIFP). The background and need for this project was previously described in the *Project and Environmental Assessment Report,* prepared by Omni Environmental LLC, which was submitted to the NJDEP and the NJEIT on October 1, 2012. The Engineer's Report, which should be reviewed in conjunction with the separately bound project drawings and specifications, presents additional detail on the basis for design of improvements described in the *Project and Environmental Assessment Report*.

As a summary of key background information presented in the *Project and Environmental Assessment Report*, the Long Hill Township Wastewater Treatment Plant (WWTP), which is owned and operated by the Township of Long Hill, is located at the end of South Warren Avenue just south of Valley Road in Long Hill Township, Morris County, New Jersey. While the Township's WWTP reliably complies with its effluent limitations, it routinely receives flow in excess of its permitted capacity of 0.9 million gallons per day (mgd), with maximum 30 day average flows greater than 1.75 mgd and peak hourly flows greater than 4 mgd. Significant operational challenges occur as a result of high peak flows.

The proposed improvements to Long Hill Township's wastewater system, which comprise improvements to both the sanitary sewer system and WWTP, consist of the following:

- Sanitary sewer system rehabilitation in areas suspected of contributing significant flow rates of infiltration and inflow, which will reduce peak flows to the WWTP thereby enhancing operation of the WWTP.

- A new influent screening system at the WWTP which will significantly reduce operating costs.

- A new UV disinfection system at the WWTP to replace an existing inefficient UV disinfection system that is at the end of its useful life thereby ensuring reliable disinfection and protection of water quality.

The objective of this project is <u>not</u> to increase the capacity of the WWTP, but rather to (1) reduce I&I flows to the WWTP to enhance operational reliability and thus protection of water quality, (2) replace an existing UV disinfection system at the end of its useful life, thereby ensuring reliable disinfection and protection of water quality, and (3) reduce the cost of operation by replacing an efficient influent screening system.

2.0 WWTP IMPOVEMENTS

2.1 Design Basis Flows

As previously described in the *Project and Environmental Assessment Report*, a Capacity Assurance Report prepared by Omni Environmental LLC included a detailed wastewater characterization for the Long Hill Township WWTP. Influent data was obtained for the years

2007, 2008 and 2009 to characterize the key influent parameters relevant to plant capacity. The data was analyzed to determine the average annual, maximum monthly (i.e. highest 30 day average), and maximum daily (i.e. highest 24 hour average) values during each year. The resulting current wastewater flows are listed below, and will act as the basis for design.

- Current Annual Average Flow = 1.10 mgd
- Current Maximum Monthly Flow = 1.75 mgd
- Current Maximum Daily Flow = 3.43 mgd
- Current Peak Hourly Flow = 4.40 mgd

Since Long Hill Township has been on a sewer ban for several years, the flows shown above are still the current flows.

As previously indicated, plant capacity is not being expanded as part of this project. Therefore, the current flows will serve as the design basis flows.

It is noted that while it is anticipated I&I will be reduced through sewer rehabilitation, the extent of reduction cannot be accurately predicted. Therefore, the current peak hourly flow of 4.4 mgd will be utilized to size the replacement UV disinfection equipment and influent screening system.

2.2 Influent Screening System

As shown in the separately bound mechanical drawings, the existing influent screens located above the sludge storage tank will be demolished and replaced with a new, more efficient, influent screening system. The influent screening system will consist of two perforated plate drum screens. Design of the influent screens is based on the Humber Rotamat Perforated Plate drum screen and will be fabricated of stainless steel. Each screen will have a peak flow capacity of 4.4 mgd. The clear opening of the perforations will be 3/8-inch.

Debris collected by each screen will be discharged directly to a conveyor compactor. Compressed screenings will be conveyed to an at-grade dumpster. The influent screens will be controlled by a local vendor supplied panel.

A design basis summary is presented in Table 2-1.

Table 2-1: Influent Screens Design Basis Summary

Influent Screens	
Number of Screens	2
Location	Above Sludge Storage Tank
Type	Perforated Plate
Screen Opening Size	3/8 inch
Hydraulic Capacity	4.4 mgd (each)
Basket Diameter	55-inches
Motor Size	2 Hp
Controls	Vendor-supplied control panel
Basis of Design	Huber Rotamat Model RPPS/1440

The screens and conveyor/compactor shall have suitable cold weather protection to ensure trouble-free winter operation in an outdoor installation to 0 deg. F.

2.3 UV Disinfection System

As shown in the separately bound drawings, the existing UV disinfection equipment will be replaced with a new horizontal open channel UV disinfection system utilizing low pressure, high intensity lamps.

The UV system will be sized for a design basis peak hourly flow of 4.4 mgd, and to provide at least a 25% safety factor in the number of lamps as required by NJAC 7:14A-23.25.

The UV system will be automatically controlled to maintain an operator-adjustable UV dose based on effluent flow and measured UV transmittance.

A design basis summary is presented in Table 2-2.

Table 2-2: UV Disinfection System Design Basis Summary

UV Disinfection System	
Number of Channels	2
Number of banks per channel	1
Number of UV Modules per bank	5
Number of Lamps per module	4
Total number of lamps	40
UV Transmittance	65%
Influent TSS	30 mg/L
UV Dose	33,000 uw-sec/cm^2
Effluent Fecal Coliform	200/100 ml
Controls	Vendor-supplies panel
Basis of Design	Trojan

2.4 Instrumentation and Control Design Codes and Standards

Instrumentation design of the vendor-supplied control panels will comply with applicable requirements and recommendations in the following codes and standards:

- Instrument Society of America (ISA)
- National Fire Protection Association (NFPA):
  - NFPA 70 National Electrical Code
  - NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- Underwriters Laboratories (UL)
- Fire Underwriters' Regulations and Local Authorities

2.5 Electrical Design Codes and Standards

Electrical design will comply with applicable requirements and recommendations in the following codes and standards:

- National Fire Protection Association (NFPA):
  - NFPA 70 National Electrical Code
  - NFPA 70E Electrical Safety in the Workplace
  - NFPA 72 National Fire Alarm Code
  - NFPA 101 Life Safety Code
  - NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- Institute of Electrical and Electronics Engineers (IEEE)
  - IEEE 141 Recommended Practice for Electric Power Distribution for Industrial Plants
  - IEEE 242 Recommended Practice for Protection and Coordination for Industrial Plants
- American National Standards Institute (ANSI)
- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories (UL)
- Illuminating Engineering Society of North America (IESNA):
  - The IESNA Lighting Handbook, Reference & Application
- United States (Federal) Standards:
  - Energy Policy Act of 2005 (EPACT 2005)
  - Energy Star Label
- Fire Underwriters' Regulations and Local Authorities

3.0 SANITARY SEWER SYSTEM REHABILITATION

3.1 Background Information

Long Hill Township's sanitary sewer collection system, which delivers wastewater flow to the WWTP, consists of the following components:

- 286,290 Linear Feet (LF) of Township-owned sanitary sewers:
  - 14,700 LF of 14-inch diameter pipe
  - 8,850 LF of 12-inch diameter pipe
  - 29,440 LF of 10-inch diameter pipe
  - 232,300 LF of 8-inch diameter pipe
- 221,325 LF of privately-owned service lateral pipe
- 1,260 manholes
- 8 pumping stations
- 15,200 LF of force mains

A portion of the system was constructed in the 1930's and 1940's, which coincided with the date of the original WWTP. Significant additions to the collection system occurred in the 1970's, coinciding with the construction-grants era and upgrades to the original WWTP. The 8-inch pipe is predominately vitrified clay pipe (VCP) and the larger diameter pipe is predominately asbestos cement pipe (ACP).

Kleinfelder/Omni reviewed the following information regarding I&I in the collection system:

- Memorandum from Justin Lizza, PE, to Richard Sheola, dated October 1, 2008 regarding the Extraneous Flow Reduction and Prevention Program.
- Dry and Wet Weather Analysis Interim Report (Phase I), September 20, 2010 by CSL Services, Inc.
- Dry and Wet Weather Analysis Final Report – Phase II, May 4, 2011 by CSL Services, Inc.
- Letter from Mario Bonaccorso to Tim Bradley summarizing I&I reduction-related work in the collection system to date.
- Collection System Maps and GIS shapefiles.
- CCTV Inspection Logs and Photographs
- Manhole Inspection Data
- Smoke Testing Photographs
- Pump Station Flow Data

The following discussion presents the prioritization for the proposed collection system rehabilitation program, the alternative technologies for pipeline and manhole rehabilitation, and a summary of costs for rehabilitation program alternatives.

3.2 Prioritization of Sanitary Sewer Rehabilitation

Kleinfelder/Omni reviewed the available data regarding the existing collection system and I&I during dry and wet weather conditions. The flow monitoring that has been performed has found that while dry-weather infiltration has not been occurring in significant quantities, wet weather I&I, or rainfall-derived I&I (RDII), is significant in many areas of the collection system. The Dry and Wet Weather Analysis Phase I Report by CSL Services, Inc. (CSL Phase I Report) identified several sub-basin prioritizations for RDII flow reduction, including the upstream sub-basins from manholes CH-94, TP-23, TP-249 and S-97.

Table 2-1 is from the CSL Phase I Report and is shown on the following page. As indicated, the sub-basins to CH-94 and TP-23 were found to be the largest contributor to RDII on a gpd/lf basis and were ranked highest.

The Dry and Wet Weather Analysis Phase II Report by CSL Services, Inc. (CSL Phase II Report) also identified several sub-basin prioritizations for RDII flow reduction, including the upstream sub-basins from manholes TP-102, TP-285, S-166 and TP-192.

Table 3-2 on the following page is from the CSL Phase II Report. As indicated, the sub-basins to TP-102 and S-166 were found to be the largest contributor to RDII on a gpd/lf basis and were ranked highest.

Table 3-1: RDII Ranking from CSL Phase 1 Report

Site	Linear Feet (LF)	Cumulative Av. Dry Weather Flow (GPD) Weekday	Cumulative Av. Dry Weather Flow (GPD) Weekend	Cumulative Infiltration (GPD)	Net Infiltration (GPD)	Net Infiltration Rate (GPD/LF)	Net Infiltration Ranking	Cumulative Projected RDII for 2 Yr 24 Hr Rain (GPD)	Net Projected RDII for 2 Yr 24 Hr Rain (GPD)	Net Projected RDII Rate for 2 Yr 24 Hr Rain (GPD/LF)	Net RDII Ranking
TP-155	8,971	265,000	246,000	112,000	0	0	10	1,142,000	170,000	7.74	5
TP-249	22,113	132,000	117,000	52,000	11,000	0.50	8	672,000	275,000	12.44	3
CH-94	16,450	37,000	33,000	12,000	12,000	0.73	7	318,000	318,000	19.33	1
CH-36	10,537	47,000	46,000	29,000	29,000	2.75	1	79,000	79,000	7.49	6
TP-192	21,962	134,000	129,000	60,000	21,000	0.96	6	300,000	0	0	10
S-04	10,837	27,000	26,000	13,000	13,000	1.20	4	40,000	40,000	3.69	8
S-97	25,377	57,000	64,000	26,000	26,000	1.02	5	260,000	260,000	10.25	4
TP-23	39,487	167,000	158,000	68,000	68,000	1.72	2	640,000	640,000	16.21	2
MR-62	38,467	247,000	226,000	74,000	56,000	1.46	3	293,000	77,000	2.00	9
MR-213	37,421	95,000	81,000	18,000	18,000	0.48	9	216,000	216,000	5.77	7
System	231,622	679,000	630,000		254,000	1.10			2,075,000	8.96	

Table 3-2: RDII Ranking from CSL Phase 2 Report

Site	Linear Feet (LF)	Cumulative Av. Dry Weather Flow (GPD) Weekday	Cumulative Av. Dry Weather Flow (GPD) Weekend	Cumulative Infiltration (GPD)	Net Infiltration (GPD)	Net Infiltration Rate (GPD/LF)	Net Infiltration Ranking	Cumulative Projected RDII for 2 Yr 24 Hr Rain (GPD)	Net Projected RDII for 2 Yr 24 Hr Rain (GPD)	Net Projected RDII Rate for 2 Yr 24 Hr Rain (GPD/LF)	Net RDII Ranking
MR-294	16,619	37,600	40,500	8,000	8,000	0.48	5	136,000	136,000	8.18	6
MR-91	19,329	56,000	57,500	19,000	19,000	0.98	1	295,000	295,000	15.26	5
TP-102	10,839	35,000	34,000	9,000	9,000	0.83	2	724,000	724,000	66.80	1
TP-285	12,550	23,000	21,600	6,000	6,000	0.47	6	282,000	282,000	22.47	3
S-166	13,819	32,500	32,200	11,000	11,000	0.79	3	462,000	462,000	33.43	2
TP-192	44,357	101,200	113,000	43,000	32,000	0.72	4	1,156,000	694,000	15.64	4
System	117,513	252,800	266,600		85,000	0.72			2,593,000	22.07	

In addition to reviewing the CSL Reports, Kleinfelder/Omni also analyzed the daily pump station and wastewater treatment flow data from 2009, the wettest year with available data. The results of this analysis are presented below in Table 3-3.

Table 3-3: Analysis of Pump Station Flows and Peaking Factors - 2009

Location	Average Flow (mgd)	Maximum Monthly Flow (mgd)	Max. Month Peaking Factor	Maximum Daily Flow (mgd)	Max. Day Peaking Factor
Wastewater Treatment Plant	1.14	2.44	**2.14**	5.73	**5.01**
Clover Hill	0.11	0.19	**1.68**	0.48	**4.19**
Morristown Rd	0.33	0.53	**1.61**	1.03	**3.12**
New Vernon	0.06	0.10	**1.65**	0.16	**2.83**
Skyline	0.25	0.42	**1.66**	0.95	**3.80**

The maximum month and maximum day peaking factors were substantially greater at the influent to the wastewater treatment plant than at the pump stations. This indicates that the areas contributory to the wastewater treatment plant by gravity (sub-basin TP) contribute more I&I. This is consistent with the data collected by CSL, with TP-102 and TP-23 having elevated levels of RDII.

Kleinfelder/Omni also reviewed the CCTV Inspection Logs showing evidence of I&I or deteriorating condition. These areas have been mapped in a geographic information system (GIS) model, along with information from the Long Hill Township GIS Geodatabase and the Morris County 100-year floodplain. This mapping, included as Figure 1 in Appendix A, helps visualize the low-lying areas in need of sewer rehabilitation work. In addition, Kleinfelder/Omni has visually inspected the sewershed to get a better understanding of the land cover, topography and condition of the collection system. Based on this information, the following ranking of areas to be rehabilitated was developed:

1. ***Treatment Plant Sub-Catchment Sewer Rehabilitation***
   The Treatment Plant Sub-Catchment showed the highest rainfall-derived I&I (RDII) during the CSL Flow Metering Studies. In addition, our analysis of the pump station flows indicates that the Treatment Plant Sub-Catchment contributes more I&I than any other section of the sewershed. These observations are not surprising, given that the Treatment Plant Sub-Catchment contains older sections of the collection system, with many pipes in need of repair and in low-lying areas. In particular, we have focused on the oldest and low-lying areas off Main Street and Central Avenue. The very high observed RDII at TP-23 and TP-102 supports a need for sewer rehabilitation in this area.

   The geographic scope of the proposed sewer rehabilitation within the Treatment Plant Sub-Catchment is shown on Figure 1 in Appendix A. A smaller area within the proposed Treatment Plant Sub-Catchment has been identified (Area 1-Alternate), to provide a lower cost option that more closely matches Long Hill's $1M budget for sewer rehabilitation.

2. ***Southern Morristown Road Sub-Catchment Sewer Rehabilitation***
   While the CSL Flow Studies and our analysis of the pump station flows do not suggest that the Morristown Road Sub-Catchment is a major contributor to I&I, there is a small section on and adjacent to the low-lying Valley Road that is in extremely poor condition and in need of rehabilitation. The geographic scope of the proposed sewer rehabilitation within the Morristown Road Sub-Catchment is shown on Figure 1.

3. ***Clover Hill Sub-Catchment Sewer Rehabilitation***
   The Clover Hill Sub-Catchment showed high levels of RDII during the CSL Flow Metering Studies and was listed as a priority. Our analysis of pump station flows also suggested that this area has a large wet-weather I&I response. However, the CCTV inspections of the sewers did not show many areas in need of repair. Based on the flow metering performed, the areas contributory to manhole CH-94 showed the highest levels of RDII. As a result, we are recommending that this area be the first priority within the Clover Hill Sub-Catchment. In addition, the sewers and manholes between CH-01 and CH-04 are in need of repair. The geographic scope of the proposed sewer rehabilitation within the Clover Hill Sub-Catchment is shown on Figure 1.

4. ***Skyline Sub-Catchment Sewer Rehabilitation***
   The Skyline Sub-Catchment showed high levels of RDII during the CSL Flow Metering Studies, and the area contributing to manhole S-166 was listed as a priority. Our analysis of pump station flows also suggested that this area has a moderate wet-weather I&I response. The CCTV inspections showed several areas in need of repair, including a section on Bungalow Terrace. The geographic scope of the proposed sewer rehabilitation within the Skyline Sub-Catchment is shown on Figure 1.

A budget of approximately $1 million has been established for initial rehabilitation efforts.

The most effective way to reduce I&I in a collection system is to completely rehabilitate entire sections of the system as opposed to scattering rehabilitation efforts across wide areas. Therefore, the initial rehabilitation efforts will focus on the Treatment Plant Subcatchment, and specifically on prioritization 1-Alternate.

3.3 Rehabilitation Options

Several options for pipeline and manhole rehabilitation have been evaluated. The pipeline options included cured-in-place pipe, fold-and-form pipe, spiral-wound pipe, sliplining and pipe bursting. The options for manhole rehabilitation included cured-in-place manhole liners, poured-in-place liners, cementitious coatings, epoxy/polymer coatings, and watertight covers. Each option has been evaluated on the basis of cost, expected performance, expected service life, impact on hydraulic conveyance capacity, and history of use.

3.3.1 Pipeline Rehabilitation Options

The different rehabilitation and renewal options for the sewer pipelines are presented below.

Cured-In-Place Pipe

Cured-in-place pipe (CIPP) is a widely-used trenchless sewer rehabilitation technology. A tubular composite product composed of a liner face, reinforcement mesh or felt material, saturated with polyester, vinyl ester or epoxy resin is inserted into a host pipe through an inversion process. The liner is hardened and cured using steam or hot water. An extensive pre-installation preparation program is required, including CCTV camera inspections, sewer cleaning, sediment removal, pre-grouting of void areas and point repairs. A full bypass of the sanitary sewage flow is typically required for the installation of the CIPP liner. Air or water pressure is used to complete the inversion process and turn the liner inside-out. The cured-in-place liner causes a small reduction in overall pipe diameter but is considered a close-fit lining system. The reduction in hydraulic capacity resulting from the smaller pipe diameter is often offset by the smoothness of the new liner. Lateral connections to the sanitary sewers are reinstated after lining with robotic cutters. Saddle connection liners can be installed at the lateral connections, and liners can be extended up the smaller-diameter laterals to help reduce I&I. After the installation of the liners, post-installation CCTV camera inspections, performance sampling and testing are recommended. The CIPP technology is also beneficial because it is a trenchless technology that does not require excavation around the existing infrastructure. This can be more important around asbestos-cement lined pipes to avoid disturbance and contact with contaminated material and soil. There are a significant number of manufacturers and contractors who support the CIPP technology in New Jersey.
Representative Manufacturer – Insituform Technologies – www.insituform.com

Fold-and-Form Pipe

Fold-and-form pipe is another close-fit trenchless sewer rehabilitation technology that utilizes a folded PVC or HDPE thermoplastic liner that expands or rebounds back to a circular shape through pressure, heat or mechanical means. The pipe is folded into a "U", "C" or other shape to reduce the cross-sectional area for easier installation. This technology also requires extensive pre-installation preparations, including CCTV camera inspections, sewer cleaning, sediment removal, pre-grouting of void areas and point repairs. A full bypass of flow is typically required as the liner is pulled into the host pipe with a winch, cables and an attached pulling cone. The liner is then warmed, expanded and reformed to achieve a close fit. The liner is then cooled inside the host pipe using circulated air. Service connections can be reinstated in-situ with robotic cutters. The fold-and-form method can be less effective for very old sewers, such as vitrified clay sewers because of inconsistencies in the host pipe. Some contractors suggested that the fold-and-form methodology is no longer frequently used and was more widespread as an alternate when the CIPP technology was proprietary. In addition, some contractors indicated that the fold-and-form technology is technically inferior to the CIPP technology. The current available research does not have a lot of information regarding the long-term performance of fold-and-form liners. It was difficult to find local contractors who currently install fold-and-form liners.
Representative Manufacturer – AM Liner II - http://www.amlinereast.com/index.htm

Spiral-Wound Pipe

Spiral-wound pipe consists of PVC-ribbed profiles with interlocking edges that connect to form a new pipe liner inside the host pipe. The process involves the fabrication of a liner in-situ by helically winding a continuous PVC strip into the pipe's shape. A benefit of the spiral-wound

technology is that bypassing flow is not necessarily required if installed during a time when wastewater is only flowing through a small portion of the host pipe. The installation process involves cleaning the host pipe, plugging laterals, fabricating the pipe liner, grouting the annular space behind the liner and reinstating the laterals by excavation or robotic cutters. The new liner does result in a smaller pipe cross-sectional area and a reduction in capacity. There is not a significant history of use or performance data of spiral-wound pipe for I&I reduction in small sanitary sewer gravity lines.
Representative Manufacturer – Sekisui SPR – http://www.sekisui-spr.com

Sliplining

Sliplining is a mature technology that involves inserting a smaller-diameter pipe or liner inside an existing host pipe. While pipes can either be continuously or segmentally sliplined, this section focuses on continuous sliplining because it is more applicable to small-diameter sewers. In continuous sliplining, a winch cable is attached to a nose cone to draw the liner into the host pipe. Solid wall HDPE pipe is typically used and is supplied in 40 foot lengths butt-fusion-welded together before being inserted into the host sewer. The pipe liners are inserted in a lead-in or "slip" trench, typically sized at a 4:1 ratio of length to depth. Hundreds of feet can be sliplined in one operation because of the flexibility of HDPE pipe. Existing wastewater flow must be controlled during installation to keep debris from lodging in the annulus. The annulus between the liner and the host pipe must be grouted after installation, and poorly-controlled grouting can lead to buckling of the liner pipe. Lateral connections to the sewer are typically reinstated from excavations outside the pipe. It should also be noted that sliplining results in a smaller diameter pipe and can be an issue particularly with existing sewers smaller than 10" in diameter.
Representative Manufacturer – Spiniello Company - http://www.spiniello.com

Pipeline Rehabilitation Recommendations

Based on the above analysis of the four different options, fold-and-form pipe and the spiral-wound pipe options were eliminated from further consideration. The fold-and-form pipe technology is simply not used very often in this geographic area, and local contractors who install it could not be located. In addition, there is limited information regarding long-term performance of this option. The spiral-wound pipe option was similarly ruled out because of a lack of data regarding history of use and long-term performance in small-diameter sanitary sewers.

The two remaining viable options were CIPP and sliplining.

Table 3-4 on the following page summarizes the advantages and disadvantages of the two types of systems.

Table 3-4: Comparison of CIPP and Sliplining

	Cured-in-Place Pipe (CIPP)	Sliplining
Structural Considerations	Old pipe must be extensively surveyed, cleaned and prepared; pre-grouting may be necessary; liner is flexible and needs support from surrounding material; only useful if pipe needs minor structural reinforcement	Can use with pipes that have structural problems; improves structural integrity of pipe if annular space is properly grouted
Hydraulic Impacts	Small reduction in diameter, often does not impact hydraulic capacity because of smooth interior	Larger reduction in diameter, especially in smaller pipes; will result in loss of cross-sectional capacity
Bypass Pumping	Required	Depending on flows, installations can be done in live lines
Land Disturbance	Minimal – no excavation; access through existing manholes	Excavations required at lateral connections and access pit
Lateral Reinstatement	Robotic cutters	Excavation
Total Cost (8" pipe)	$30-50 per linear foot	$50-100 per linear foot*

*Sliplining costs increase significantly when many laterals connections require reinstatement. In addition, there is a greater risk for utility conflicts, project delays, and change orders on sliplining projects.

The above comparison of the CIPP and sliplining technology shows that the only two advantages of sliplining are the ability to use it in pipes with structural problems and that bypass pumping is not required depending on existing flows. The benefits of CIPP over sliplining include smaller hydraulic impacts, significantly less land disturbance (especially with many lateral connections), and reduced costs for this application. The use of the CIPP technology would also result in less impact on residents and traffic.

Based on this information and the current condition and characteristics of the collection system, the sewer rehabilitation design will be based on CIPP.

3.3.2 Manhole Rehabilitation Options

Several options for manhole rehabilitation were researched and evaluated, including cementitious coatings, epoxy/polymer coatings, cured-in-place liners and poured-in-place liners. The different rehabilitation and renewal options for the manholes are presented below.

<u>Cementitious Coatings</u>

Cementitious coatings are very widely used in the manhole rehabilitation industry and are generally the least expensive option for manhole coatings. The surface of the existing manhole

must be very well cleaned and prepared. High-pressure water blasting is often used to properly clean manhole surfaces. There is a wide range of cementitious coatings available, with different additives for resistance to stress, water, corrosion and flexure on the walls of the existing manhole. In general, calcium aluminate cement should be used to enhance corrosion resistance. The material can either be hand-applied or sprayed. Budgetary costs for cementitious coatings are approximately $150 to $175 per vertical foot of manhole.
Representative Manufacturer – Permacast Mortars – http://permaform.net

Epoxy/Polymer Coatings

Epoxy and polymer coatings provide excellent corrosion protection properties, and are often used as a liner over cementitious coatings. As with cementitious coatings, excellent cleaning and preparation of the existing manhole is essential to achieving an effective coating system. While epoxy coatings are more common, polymer coatings such as polyurethane and polyurea are becoming more accepted and have the advantage of curing very quickly. As with the cementitious coatings, there are many types of coatings with different additives and mixtures available for different applications. Coating systems that have an epoxy or polymer component are typically about twice as expensive as cementitious coatings, with costs ranging widely from $250 to $400 per vertical foot of manhole.
Representative Manufacturer – Parsons Env.– http://www.parsonenvironmental.com

Cured-in-Place Liners

Cured-in-place (CIP) liners are a variation of the CIPP technology used for pipeline renewal, as discussed above. The CIP manhole liners provide a larger degree of structural support than the cementitious or epoxy/polymer coatings do and provide extremely high resistance to corrosion and groundwater infiltration. Typically, these manhole liners consist of a reinforcement mesh, such as fiberglass, saturated with polyester, vinyl ester or epoxy resin. The liners are cured-in-place using steam, hot water, heat or pressure. This technology is relatively new for use in manholes, with widespread use only in the last 5 years. However, the technology has an excellent record when used in pipeline renewal projects. Literature regarding this technology indicates excellent performance for corrosion resistance, I&I reduction, structural improvement and ability to resist freeze/thaw cycles. CIP manhole liners are more expensive than cementitious or epoxy/polymer coatings, at costs of about $500 per vertical foot of manhole.
Representative Manufacturer – Poly-Triplex – http://www.poly-triplex.com

Poured-in-Place Liners

Poured-in-place (PIP) liners are used to rehabilitate severely deteriorated manholes with a strong structural concrete lining. The PIP liners essentially provide complete manhole replacement without excavation. Steel forms are first placed within the manhole conforming to the interior dimensions. High strength concrete is then poured into the annulus between the forms and the old wall, thereby building a new manhole within the existing manhole. Additives can be used within the concrete to improve corrosion resistance. Epoxy or polymer liners can also be used to improve corrosion resistance of the PIP liner. The cost of the PIP liners is more expensive than the CIP liners, at approximately $750 per vertical linear foot.
Representative Manufacturer – Permaform – http://permaform.net

The four manhole rehabilitation options presented above represent a wide range of manhole rehabilitation systems that each has its own advantages and disadvantages. Generally, as the costs increase, the products provide higher levels of structural support and corrosion resistance.

Table 3-5 below presents the guidelines that will be used for deciding which manhole option to use based on condition:

Table 3-5: Manhole Rehabilitation Guidelines

Existing Conditions	**Recommended Rehabilitation Method**	**Cost (per vertical foot)**
No major defects	Calcium aluminate cementitious coating with additive to prevent I&I	$150
Existing corrosion evident	Epoxy/polymer coating	$250
Minor structural deficiencies and evidence of severe I&I	Cured-in-place manhole liner	$500
Major structural deficiencies	Poured-in-place liner	$750

Based on review of available information and discussions with Long Hill Township, most of the manholes to be rehabilitated will require cementitious or epoxy/polymer coatings. These coating treatments will provide reductions in I&I and improve corrosion resistance.

If some of the manholes exhibit structural deficiencies, such as cracking and severe deterioration, the more expensive CIP and PIP liners will be utilized.

3.4 Sewer System Rehabilitation Costs and Recommendations

As presented and discussed above, there are several priorities for the collection system rehabilitation program. The recommended pipe rehabilitation technology is CIPP lining, while the manholes rehabilitation technology is cementitious lining for I&I reduction.

Table 3-6 on the following page shows the budgetary costs for the various sewer rehabilitation prioritizations. The costs include saddle connections and partial lining for laterals.

Based on the Township's target budget of $1 million for sewer rehabilitation, the sewer system rehabilitation design will be based on Priority 1- Alternate. The separately bound design drawings are based on rehabilitating this area of the sanitary sewer system.

As shown in Table 3-6, the construction cost estimate for rehabilitating this area of the sanitary sewer system is $1.32 million.

Table 3-6: Preliminary Sewer Rehabilitation Cost Estimates

Item/Description	*Quantity*	*Unit/Basis*	*Unit Budgetary Cost*	*Item Budgetary Cost*
Priority 1 - Area in Treatment Plant Subcatchment (Total)				
Pipe CIP Lining	22,300	LF	$ 35	$ 780,500
Connections - Saddle and Lateral Liner	350	EA	$ 3,000	$ 1,050,000
Manhole Lining (Cementitious 10' depth)	88	EA	$ 1,500	$ 132,000
Unit Price & Other Item Subtotal				*$ 1,962,500*
Percentage Items				
Contractor OH&P	21%			$ 412,125
Contingency	15%			$ 294,375
Percentage Items Subtotal				*$ 706,500*
Priority 1 - Construction Cost				**$ 2,669,000**
Priority 1 - Alternate - Area in Treatment Plant Subcatchment (South)				
Pipe CIP Lining	10,750	LF	$ 35	$ 376,250
Connections - Saddle and Lateral Liner	175	EA	$ 3,000	$ 525,000
Manhole Lining (Cementitious 10' depth)	45	EA	$ 1,500	$ 67,500
Unit Price & Other Item Subtotal				*$ 968,750*
Percentage Items				
Contractor OH&P	21%			$ 203,438
Contingency	15%			$ 145,313
Percentage Items Subtotal				*$ 348,750*
Priority 1 - Alternate - Construction Cost				**$ 1,317,500**
Priority 2 - Area in Southern Morristown Subcatchment				
Pipe CIP Lining	2,650	LF	$ 35	$ 92,750
Connections - Saddle and Lateral Liner	30	EA	$ 3,000	$ 90,000
Manhole Lining (Cementitious 10' depth)	15	EA	$ 1,500	$ 22,500
Unit Price & Other Item Subtotal				*$ 205,250*
Percentage Items				
Contractor OH&P	21%			$ 43,103
Contingency	15%			$ 30,788
Percentage Items Subtotal				*$ 73,890*
Priority 2 - Construction Cost				**$ 279,140**
Priority 3 - Area in Clover Hill Subcatchment				
Pipe CIP Lining	14,860	LF	$ 35	$ 520,100
Connections - Saddle and Lateral Liner	150	EA	$ 3,000	$ 450,000
Manhole Lining (Cementitious 10' depth)	82	EA	$ 1,500	$ 123,000
Unit Price & Other Item Subtotal				*$ 1,093,100*
Percentage Items				
Contractor OH&P	21%			$ 229,551
Contingency	15%			$ 163,965
Percentage Items Subtotal				*$ 393,516*
Priority 3 - Construction Cost				**$ 1,486,616**
Priority 4 - Area in Skyline Subcatchment				
Pipe CIP Lining	14,340	LF	$ 35	$ 501,900
Connections - Saddle and Lateral Liner	125	EA	$ 3,000	$ 375,000
Manhole Lining (Cementitious 10' depth)	75	EA	$ 1,500	$ 112,500
Unit Price & Other Item Subtotal				*$ 989,400*
Percentage Items				
Contractor OH&P	21%			$ 207,774
Contingency	15%			$ 148,410
Percentage Items Subtotal				*$ 356,184*
Priority 4 - Construction Cost				**$ 1,345,584**

4.0 PRELIMINARY CONSTRUCTION COST ESTIMATE SUMMARY

The construction cost estimate summary for the Wastewater System Improvements Project is presented in Table 4-1.

Table 4-1: Preliminary Construction Cost Estimate Summary

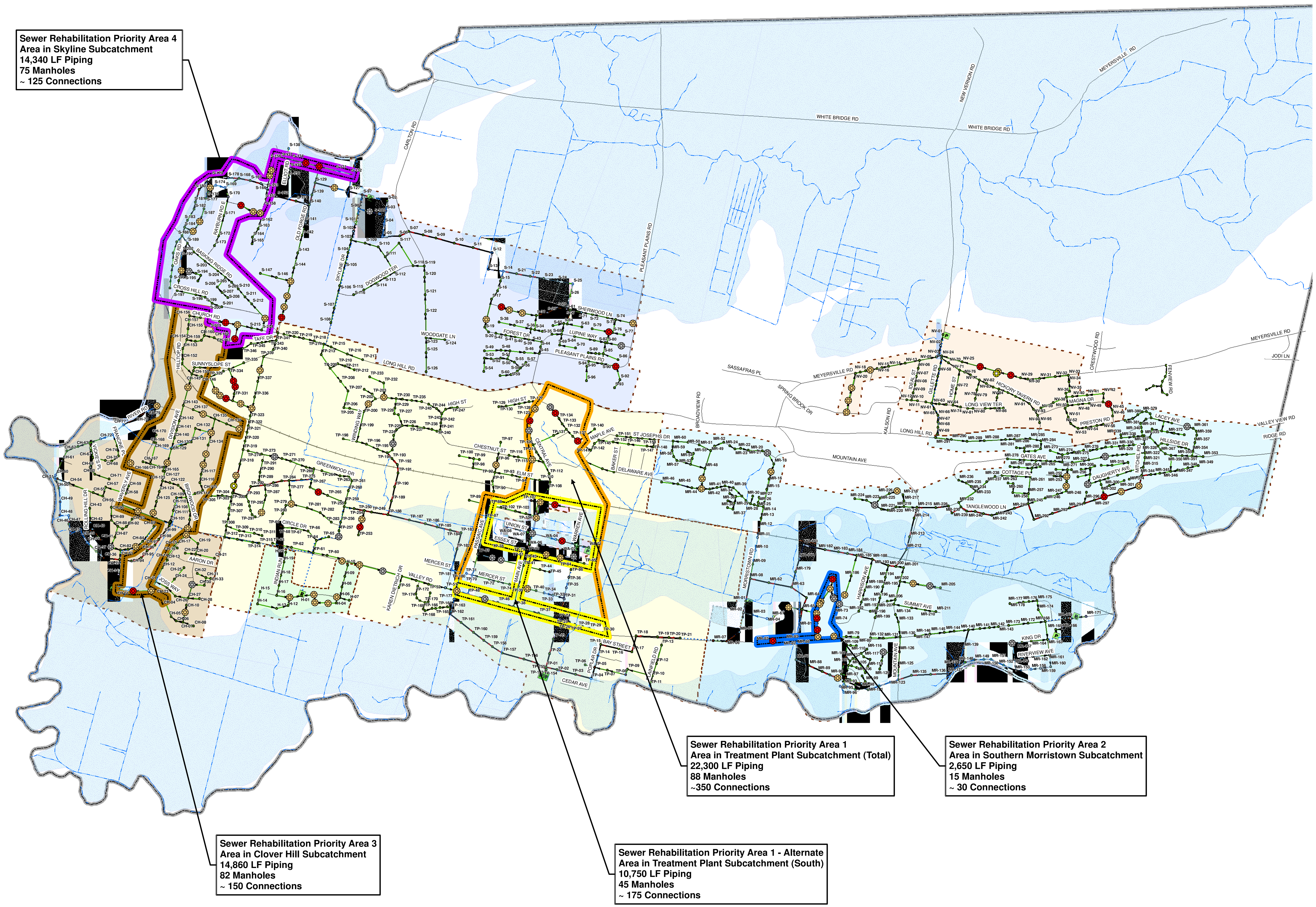
Component	Preliminary Construction Cost
Wastewater Treatment Plant Improvements	
Replacement Influent Screening System	$1.34 million
Replacement UV Disinfection System	$0.52 million
WWTP Subtotal	*$1.86 million*
Sewer Rehabilitation – Priority 1-Alternate	$1.32 million
Total	**$3.18 million**

Appendix A

Figure 1 Sewer Rehabilitation Prioritization Areas

Figure 1
Sewer Rehabilitation Prioritization Areas

Long Hill Township
Sewer System Rehabilitation
Morris County, New Jersey



LEGEND

Sewer System Problem Area Ratings

- Minor
- Moderate
- Moderate/Severe
- Severe

Sewer System Rehabilitation Prioritization Areas

- Area 1 - Treatment Plant
- Area 1 Alternate - Lower Treatment Plant
- Area 2 - Morristown Road
- Area 3 - Clover Hill
- Area 4 - Skyline

Sub-Catchment Areas

- Clover Hill
- Heritage
- Morristown Road
- New Vernon
- Skyline
- Treatment Plant
- Warren Ave
- Force Main
- Collector
- Interceptor
- Railroad
- Long Hill Township Boundary
- Streams
- Floodplain

PROJECT NO.: 2629G

DRAWN: 02-19-13

DRAWN BY: BJF

CHECKED BY: TDB

0 1,000 2,000 3,000 4,000
Feet

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